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507104 22 September 2000 (22.09.2000) NZ(71) Applicant (for all designated States except US): **NEW ZEALAND DAIRY BOARD** [NZ/NZ]; Pastoral House, 25 The Terrace, Wellington (NZ).

(72) Inventors; and

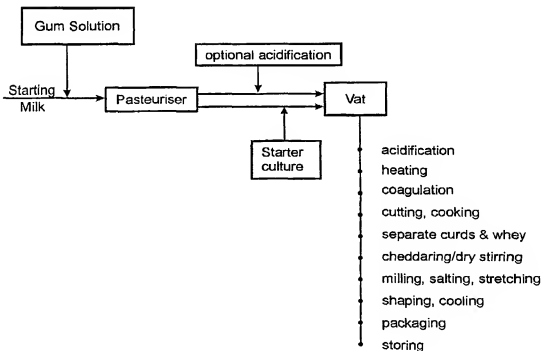
(75) Inventors/Applicants (for US only): **JOHNSTON, Keith** [NZ/NZ]; 11 Sheraton Grove, Palmerston North (NZ). **MAIN, Allan** [NZ/NZ]; 104 Manawatu Street, Palmerston North (NZ). **BENNETT, Brian** [NZ/NZ]; 24 Beach HavenPlace, Paraparaumu, Kapiti Coast (NZ). **HUGHES, David** [NZ/NZ]; 66 St Johns Terrace, Tawa, Wellington (NZ). **BRUCE, Alastair** [NZ/NZ]; 67 Sefton Street, Wadestown, Wellington (NZ).(74) Agents: **A J PARK** et al.; Calhoun, Douglas, C. 6th Floor Huddart Parker Building, Post Office Square, P.O. Box 949, 6015 Wellington (NZ).

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(54) Title: PROCESS FOR MAKING CHEESE CONTAINING GUM



(57) Abstract: A process for making cheese comprising the steps: starting with a milk composition that has a milk fat content of more than 0.3%, adding a gum preparation to the milk, adding a starter to the milk to form a cheese milk, coagulating the cheese milk, cutting the coagulum to separate curd and whey, draining whey from the curd, and shaping and cooling the curd. The difference over the prior art is the addition of gum to the milk before the starter is added.



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Process for making cheese containing gum**FIELD OF THE INVENTION**

5 The present invention relates to a novel process of making cheese containing gum, specifically although by no means exclusively, to a process of making mozzarella or mozzarella-like (pizza) cheese containing gum, and to a cheese product made by said process.

BACKGROUND OF THE INVENTION

10 Recent cheese making processes have concentrated on the production of low fat, low cholesterol and fat free cheeses which have the texture and flavour of full fat cheese, for the increasing health conscious public and also aimed at the weight reduction and
15 slimming food market.

In particular, a number of substances have been added to the cheese making process as fat replacement agents including starch (US 5,547,513; US 5,679,396; US 5,277,926; US 5,807,601; US 4,552,774; US 5,665,414); gums, such as carrageenan, xanthan,
20 agar, alginate, guar and cellulose gels (US 5,895,671; US 5,395,630; US 5,090,913; WO 86/00786); as well as both starches and gums together or in combination with other additives such as emulsifiers, flavours, stabilisers, colourants, dairy solids, cheese powders, and the like, (US 5,902,625; US 5,895,671; NZ 303546; US 5,679,396; US 5,532,018). In particular, the starting milk for these processes is either
25 fat free or contains less than 0.3% fat (US 5,395,630; US 5,090,913).

Carrageenan appears to be a preferred gum in the prior art processes and has been used in a number of instances to enhance production of low fat cottage cheese and soft acid set coagulated cheeses. These methods have involved the use of carrageenan to tie up
30 protein material from whey thereby increasing the yield levels (WO 86/00786).

To date, there is no teaching that gums, such as carrageenan may be useful in a process of cheese making wherein the starting milk has a relatively high fat content to produce low, reduced or full fat cheese, including what processing parameters would be required to produce such cheeses.

5

In addition, for all cheese making processes it is important to maintain the compositional and functional characteristics of the final cheese product at a standard acceptable by the industry and consumer.

10 In particular, melt and flavour characteristics are important for mozzarella cheese especially for cheese made for the pizza making industry. Any method of cheese making that can provide flexibility in the functional characteristics of the end cheese product gives the cheese making industry a way of producing a wide variety of cheese having the required functional characteristics in a consistent manner. This is
15 beneficial to the cheese making industry, large consumers such as the pizza industry, as well as individual consumers.

It is an object of the present invention to provide such a process and/or at least to provide the public with a useful choice.

20

SUMMARY OF THE INVENTION

In a first embodiment, the present invention provides a process of manufacturing cheese wherein a gum preparation is added to a milk composition before being
25 pasteurised, the milk is then ripened with a starter culture and/or acid to produce a cheese milk and the cheese milk coagulated. The coagulum is cut to separate curd from whey and the whey drained therefrom. The curd is then shaped and cooled.

In a second embodiment, the present invention provides a process of manufacturing
30 cheese wherein a gum preparation is added to a pre-pasteurised milk composition. The milk is then ripened with a starter culture and/or acid to produce a cheese milk and the

cheese milk coagulated. The coagulant is cut to separate curd from whey and the whey drained therefrom. The curd is then shaped and cooled.

Other additives common to cheese making process may be added at any suitable stage of the above mentioned processes to alter any functional characteristic or improve flavour, texture, colour and the like, as would be understood by a person of skill in the art.

The cheese made by the above processes may comprise soft, semihard, hard and extra hard cheeses including mozzarella whereby the mozzarella is made without a heating and stretching step.

However, more traditional mozzarella cheese making processes may be employed which include a heating and stretching step. Thus, in a third embodiment, the present invention provides a process of manufacturing a mozzarella or mozzarella-like (pizza) cheese wherein a gum preparation is added to a milk composition and the milk composition pasteurised. The milk is then ripened with a starter culture and/or acid to form a cheese milk, and the cheese milk coagulated. The coagulum is cut to separate curd from whey and the whey drained therefrom. The curd is then heated and stretched, extruded, molded and cooled.

In a fourth embodiment, the present invention provides a process of manufacturing a mozzarella-like cheese wherein a gum preparation is added to a pre-pasteurised cheese milk composition. The milk composition is then ripened with a starter culture and/or acid to form a cheese milk, and a the cheese milk coagulated. The coagulum is cut to separate curds from whey and the whey drained therefrom. The curd is then heated and stretched, extruded, molded and cooled.

Other additives common to cheese making process may be added at any suitable stage of the above mentioned processes to alter any functional characteristic or improve flavour, texture, colour and the like, as would be understood by a person of skill in the art.

The present invention also provides a cheese produced by the processes of the invention which surprisingly have enhanced functional properties.

5 In particular, the present invention is directed to a mozzarella or mozzarella-like (pizza) cheese produced by a process according to the invention that surprisingly has enhanced functional properties. By mozzarella and mozzarella-like (pizza) cheese is meant a cheese made using a process of the present invention, which has stringy characteristics on melting.

10 DESCRIPTION OF THE FIGURES

The present invention will now be described with reference to the figures of the accompanying drawings in which:

15 Figure 1 shows a schematic drawing of the process of a first embodiment of the invention;

20 Figure 2 shows a schematic drawing of the process of a second embodiment of the invention; and

Figure 3 shows a score chart for assessing functionality of the cheese made by the process of the invention.

25 DETAILED DESCRIPTION OF THE INVENTION

The present invention provides an alternative process of making a cheese containing gum, whereby said gum results in an increase in moisture content and improved functional characteristics of said cheese. When the cheese is mozzarella or mozzarella-like (pizza) cheese, such functional characteristics include improved melt and sensory characteristics that are especially desirable in the pizza making industry.

Previously, gums such as carrageenan have been added in cheese making processes as fat replacers in processes for producing fat free or low fat cheese products. It was the aim of such processes to provide a low fat or fat free cheese product which had the same texture and flavour as their full fat cheese counterparts. In these prior art processes, the gums were added at various stages of the cheese making process, more usually at the salting stage, and often required further additives to interact with the gums and the whey proteins. In addition, it was also a requirement of these prior art processes to begin the cheese making process with fat free or low fat (less than 0.3%) starting milk.

The process of the present invention provides for the first time, the processing parameters required to make a low, reduced or full fat cheese, including mozzarella or mozzarella-like (pizza) cheese, containing gum from a starting liquid milk containing relatively normal fat content, as well as the cheeses made by the process of the invention having enhanced functional properties.

In particular gum is not added to the fat containing starting milk composition in the processes of the present invention as a fat replacer, but as a functionality enhancer and provides cheese with an increase in moisture content and enhanced functional characteristics. In particular, the molten or cooked mozzarella or mozzarella-like (pizza) cheese made according to the process of the invention has improved melt and flavour characteristics. Without being bound by theory, it is thought that the gum, in solution, is activated by heat enabling interaction with the casein before the coagulation step. In the case of the processes whereby gum is added to the starting milk before the pasteurisation step, the heat of pasteurisation is thought to activate the gum solution. Where gum is added to a pre-pasteurised starting milk composition, a number of heating steps in the process could activate the gum. For example, when a gum solution is pre-heated (for sterilisation purposes) before being added to the starting milk or by the temperature of the cheese milk during coagulation or, during the heating and stretching step in embodiments which include such a step.

The description will now be limited to the process of making mozzarella or mozzarella-like cheese, but it will be understood by a skilled person that any other type of cheese may be made by the processes of the present invention.

- 5 The present invention provides a process of making mozzarella or mozzarella-like (pizza) cheese comprising the steps:
- a. providing a starting milk composition having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;
 - 10 b. adding a gum preparation to the milk composition of step a;
 - c. pasteurising the milk composition of step b;
 - d. adding a starter culture and/or acid (mineral and/or organic) to the milk composition to form a cheese milk;
 - e. coagulating the cheese milk composition;
 - 15 f. cutting the coagulum to separate curd and whey;
 - g. draining away the whey from the curd; and
 - h. shaping and cooling the curd.

Preferably, the process further comprises a step of heating and stretching the curd at a
20 curd temperature of between about 50°C to 80°C after step g, and before step h.

The general steps of this preferred process are set out in Figure 1.

The starting milk may be selected from one or more of the group comprising whole fat
25 milk; semi skimmed milk; skimmed milk; butter milk; butter milk retentate/concentrate and whey protein retentate/concentrate or from products made from milk as would be appreciated by a person skilled in the art. One or more powders, such as whole milk powder, skimmed milk powder, whey protein concentrate powder, whey protein isolate powder and buttermilk powder or other
30 powders made from milk, reconstituted or dry, singularly or in combination may also be selected as the starting milk or be added to the starting milk.

The starting milk may be sourced from any milk producing animal.

The protein and fat composition of the starting milk composition is altered by a process known as standardisation to give a protein/fat ratio of between 0.5:1 and 6.0:1.

5 The process of standardisation involves removing the variability in the fat and protein composition of the starting milk to achieve a particular end cheese composition. Traditionally, standardisation of milk has been achieved by removing nearly all the fat (cream) from the starting milk (separation) and adding back a known amount of cream thereto to achieve a predetermined protein/fat ratio in the cheese milk. The amount of
10 fat (cream) required to be removed will depend upon the fat content of the starting milk and the required end cheese composition. However, the cheese milk has a fat content of at least 0.3%, preferably 0.5-6.0% fat to give concentration in the final cheese product of between about 4-30 wt%. Additionally or alternatively, the protein concentration may be altered by adding a protein concentrate such as a UF retentate or
15 powder concentrate to a milk starting composition, or by any other method as would be appreciated by a person skilled in the art.

The gum is selected from one or more of the group comprising kappa carrageenan, iota carrageenan, lambda carrageenan, locust bean gum, alginate, xanthan, cellulose gum,
20 guar, and any other suitable hydrocolloid.

Preferably the gum is a carrageenan and most preferably the gum is predominantly kappa carrageenan.

25 The gum preparation may be a dry powder or a solution. The gum preparation is preferably a solution whereby a gum powder is dispersed in either water or milk at concentrations of between about 1 and 25 wt%, preferably between about 8-12 wt%, at temperatures of between 2°C and 30°C to prepare a bulk gum solution. Sufficient bulk gum solution is then added to the standardised starting milk before pasteurisation to
30 give a concentration of gum in the starting milk of between about 0.005-0.25 wt%, preferably 0.010-0.2 wt%, most preferably between about 0.015-0.15 wt%. Such concentrations of gum in the starting milk result in a gum concentration in the final

starting milk of approximately $1.00-100 \times 10^{-3}$ g/g of protein, preferably $1.4-60 \times 10^{-3}$ g/g of protein, most preferably $4.0-45 \times 10^{-3}$ g/g of protein. It has been demonstrated, surprisingly, that up to 95% of the gum present in the starting milk will be retained in the final cheese product. As the gum preparation is added to the starting milk before pasteurisation in this embodiment it does not require separate pasteurisation.

Pasteurisation of the starting milk takes place under standard conditions, namely, heat treating the milk at a temperature and time sufficient to kill pathogens, (typically 72°C for 15 seconds).

After pasteurisation, the standardised starting milk is transferred to a fermentation vat at a suitable temperature, generally chosen to prevent localised protein precipitation during acidification.

A bulk starter culture and food grade acid (at approximately 10%) are added to the starting milk in order to lower the pH of the milk to a preferred pH of about ≥ 5.2 to form a cheese milk. Alternatively, the pH may be lowered by starter culture alone, or by direct acidification alone as would be appreciated by a person skilled in the art.

The starter culture can be mesophilic or thermophilic or a mix and added at 0.1-2.0 % (neutralised) or 0.1-6.0% (unneutralised) of the milk volume. Examples of starter cultures are: *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus helveticus*, *Lactococcus lactis subspecies cremoris*, *Lactococcus lactis subspecies lactis*.

The starter culture may be added to the starting milk either whilst the milk is en-route to the fermentation vat or once it is in the vat. Likewise acidification may take place either en-route or once the starting milk is in the vat.

Where direct acidification is required, sufficient food grade acid (preferably an organic acid) at an appropriate dilution is added to reduce the pH of the pasteurised standardised milk to between pH 5.2 and normal milk pH.

- 5 Once the starter culture and acid (if required) have been added, the milk is heated to its set temperature (30-44°C) depending on the starter culture used. The starter culture may be allowed to grow and the pH to drop further before addition of a coagulant such as a coagulating enzyme. Coagulating enzyme (eg chymosin in rennet, microbial rennet) may be added to the cheese milk to aid in the cheese milk being converted
10 from a liquid to a gel or semi solid at 30°C to 42°C as is known by those skilled in the art

- After a coagulum has been formed and reached an adequate firmness, the curd is cut to give curd particles suspended in whey. The temperature of the curd and whey mixture
15 is raised to the cook temperature at a rate of approximately 1°C /6 min and the curd and whey are then cooked at a cook temperature of between 36°C to 44°C. The exact cook temperature will vary depending on the starter culture used and final cheese moisture targets as would be understood by a person of skill in the art.

- 20 During the cooking phase the curd is stirred and can also be washed by draining a portion of the whey from the vat and adding back the same volume of water, or by adding back less or more water than the volume drained, or by adding water without draining any whey. It is also possible to add hot water to wash and cook the curd at the same time.

25

The curd is cooked until a target pH is reached and the curd is then separated from the whey by allowing the whey to drain from the curd.

- Through the action of the residual starter bacteria the pH of the fresh curd is allowed to
30 drop to a target level of between 5.0-6.0. The pH can be adjusted using organic or mineral acid if required or by adding an acidity regulator (eg Glucono Delta Lactone –

GDL). The time between cutting and draining is dependent on the starter system used, the cooking temperature and the draining pH target.

The drained curd may be allowed to knit together to form a 'chicken-breast' structure, a process that results in a continuous mat of curd. Alternatively the curd may be dry stirred and/or pressed in block form. The time required for the curd to knit together in a solid mass is dependant on the starter system used, the cooking temperature and the milling pH target as would be understood by a skilled artisan.

At a target pH the curd is milled. Milling involves cutting the mat of cheddared curd into finger-sized pieces of curd which can be easily and effectively salted.

In more traditional mozzarella processes only a portion of the salt is added at this point or none at all. In these cases salt is added during stretching and/or brining after stretching.

If salt is added after milling, time is allowed for the salt to penetrate the curd (mellowing).

The heating and stretching step takes place at a curd temperature of between about 50°C and 80°C and may occur by immersing the curd in hot water or hot whey as in the traditional method, or may be heated and stretched in a dry environment as described in US 5,925,398. In either method, the curd is heated and stretched into a homogenous, plastic mass. Preferably the curd is heated to a curd temperature of between about 50°C to 71°C using equipment common in the art, such as a single or twin screw stretcher/extruder type device or steam jacketed and/or infused vessels equipped with mechanical agitators (waterless cookers).

Traditionally the hot curd is immediately extruded into molds or hoops and the cheese cooled by spraying chilled water/brine onto the surface of the hoops. This initial cooling step hardens the outside surface of the block providing some rigidity. Following this initial cooling the cheese is removed from the molds and placed in a

salt brine (partially or completely saturated) bath for a period of time to completely cool the cheese and enable uptake of the salt to the required level. Once cooled the cheese is placed in plastic liners, air removed and the bag is sealed. Alternatively, hot stretched curd may be extruded into sheet-like form and directly cooled without
5 molding.

An alternative process sometimes used in commercial practice is to completely dry salt the curd, mellow, stretch and pack directly into plastic liners contained in hoops and the liners sealed. The hoops plus cheese are then immersed in chilled water.
10 Cooled cheese is stored at between 2°C to 10°C. Once ready for use the cheese may be used directly or the block frozen or the block shredded and the shred frozen.

It is also possible to produce a mozzarella or mozzarella-like (pizza) cheese by the processes of the present invention which does not include a heat stretch step, as
15 described in US 5,942,263.

Other additives common to the cheese making process may be added, including non-dairy ingredients such as stabilisers, emulsifiers, natural or artificial flavours, colours, starches, water, additional gums, lipases, proteases, mineral and organic acid,
20 structural protein (soy protein or wheat protein), and anti microbial agents as well as dairy ingredients which may enhance flavour and change the protein to fat ratio of the final cheese. Such additives may be added at any suitable step in the process as would be understood by a person skilled in the art. For example, salts such as calcium chloride are useful in aiding coagulation and may be added with the starter culture
25 during coagulation. The flexibility of allowing any combination of additives to be added at any step in the process allow the final composition of the cheese to be precisely controlled, including the functionality characteristics.

In a further embodiment, the present invention provides a process of making a
30 mozzarella or mozzarella-like (pizza) cheese comprising the steps:

- a. providing a starting milk composition having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;
- b. pasteurising the milk composition of step a;
- c. adding a gum preparation to the milk composition of step b;
- 5 d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- e. coagulating the cheese milk composition
- f. cutting the coagulum to separate curd and whey;
- g. draining away the whey from the curd; and
- 10 h. shaping and cooling the curd.

Preferably the process further comprises a step of heating and stretching the curd at a curd temperature of between about 50°C to 80°C after step g and before step h.

- 15 The general steps of this process are set out in Figure 2. The starting milk is selected and standardised as described above.

The gum is selected from one or more of the group comprising kappa carrageenan, iota carrageenan, lambda carrageenan, locust bean gum, alginate, xanthan, cellulose gum,
20 guar, and any other suitable hydrocolloid.

Preferably the gum is a carrageenan and most preferably the gum is predominantly kappa carrageenan.

- 25 The gum preparation may be a dry powder or a solution. The gum preparation is preferably a solution whereby a gum powder is dispersed in either water or milk at concentrations of between 1 and 25 wt%, preferably 8-12 wt%, to prepare a bulk gum solution. The bulk gum solution may be heated for sterilization purposes and/or to activate the gum before adding to the cheese milk. Sufficient bulk gum solution is
30 then added to the standardised pre-pasteurised starting milk to give a concentration of gum in the starting milk of between about 0.005-0.25 wt%, preferably between about 0.010-0.2 wt%, most preferably between about 0.015-0.15 wt%. Such concentrations

of gum in the starting milk result in a gum concentration in the milk of approximately $1.00-100 \times 10^{-3}$ g/g of protein, preferably $1.4-60 \times 10^{-3}$ g/g of protein, most preferably $4.0-45 \times 10^{-3}$ g/g of protein. It is expected that up to 95% of the gum preparation will be retained in the final cheese product. The gum may be added to the pasteurised starting milk either en-route to the fermentation vat or once the pasteurised starting milk has been transformed in the vat.

The coagulation, cutting, draining, heating, stretching, shaping, packaging, etc steps are carried out as described above. In addition, as discussed above, the cheese may be produced without a heating and stretching step as described in US 5,942,263.

Again, other additives common to the cheese making industry may be added to control the final functionality characteristics of the cheese product. Such additives include non-dairy ingredients such as stabilisers, emulsifiers, natural or artificial flavours, colours, starches, water, additional gums, lipases, proteases, mineral and organic acid, structural protein (soy protein or wheat protein), and anti microbial agents as well as dairy ingredients which may enhance flavour and change the protein to fat ratio of the final cheese. Such additives may be added at any suitable step in the process as would be understood by a person skilled in the art. For example, salts such as calcium chloride are useful in aiding coagulation and may be added with the starter culture during coagulation.

In a further embodiment, the present invention provides a mozzarella or mozzarella-like cheese product produced by the processes of the invention. Such cheese has improved functionality characteristics on cooking including:

- decreased blister size
- increased blister coverage
- whiter background colour (of the melted cheese)
- a more tender mouthfeel while retaining good stretch characteristics
- reduced oiloff
- reduced transparency

In addition the inclusion of the gum in the process of the present invention:

- increased cheese yield (total kg cheese)
- improved shredability/diceability
- 5 - increased the window of functional acceptance.

The present invention also provides a food product comprising the mozzarella or mozzarella-like cheese of the present invention, such as a pizza.

10 Any ranges mentioned in this patent specification are intended to inherently include all of the possible values within the stated range.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or
15 collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

20 The invention consists in the foregoing and also envisages constructions of which the following gives examples.

General Manufacturing Protocol

25 Starting milk (with varying protein to fat ratios, typically 1.3) was pasteurised (72 C/15 s) and various gums at varying concentrations (eg Gelcarin CH7352, a commercial kappa carrageenan product supplied by FMC, 6-10% dispersed in milk or water) was added to the milk before or after pasteurisation as set out below for each example. A range of starter milk gum concentrations were evaluated (typically
30 0.025%).

A culture of lactic acid producing bacteria plus dilute acetic acid was added to the pasteurised milk and gum compositions to bring the pH down to 6.10- 6.20 to produce a cheesemilk. The cheesemilk was heated to 36°C and a coagulant (Chymax or Fromase) was added and the cheesemilk allowed to set. The coagulum was cut and stirred for approximately 35-50 minutes and then the whey was drained from the curd. The curd was then allowed to knit together for approximately 45-60 minutes and then milled. Sufficient salt was added to the milled curd to reach a target of 1.4% in the final cheese. After mellowing the salted curd was stretched at curd temperature of 58-60°C, packaged and molded and cooled in chilled water. Final cheese was stored at approximately 5°C until ready for functionality evaluation.

EXAMPLE 1:

mozzarella/mozzarella-type cheese made where gum has been added prior to pasteurisation

In this example 4 cheeses were made according to the protocol described above. Cheeses 1 and 3 were the control cheeses where no gum was added. In cheeses 2 and 4, Gelcarin CH7352 was added to the starter milk (0.025%) before pasteurisation. Composition and functionality results for these cheeses are shown in Tables 1 & 2 respectively.

Table 1: Chemical composition

Cheese No.	1	2	3	4
Fat (%)	21.0	20.0	21.5	19.5
Moisture (%)	46.9	48.6	47.3	49.3
Salt (%)	1.27	1.32	1.36	1.39
PH	5.44	5.47	5.48	5.50

Table 2: Functionality*

Age of cheese tested	6 weeks		4 weeks	
	1	2	3	4
Cheese No.	5-10	20-25	10-15	10-15
Blister coverage (%)	5-10	5-10	5-10	0-5 (on average smaller than control)
Background colour	White/pale yellow	Whiter than control	White/pale yellow	Whiter than control, greater yield, less transparency
Melt	Complete, sauce colour showing through	Complete, no sauce colour showing through	Complete	Complete
Oil Off	Slight	Less than control	Slight	Less than control
Stretch length (mm)	300	>400	> 400	300-400
Stretch type	Fibrous/webby	Fibrous	Slightly fibrous	Fine
Tenderness	Initially tender, goes slightly chewy on further chewing although some breakdown in mouth	Initially tender, breaks down in the mouth on further chewing and more tender than control	Initially tender, goes tough, chewy and mealy on further chewing	Initially tender, less mealy on chewing and breaks down in the mouth.
Flavour	Bland	Bland	Bland	Bland

* Functionality assessed by pizza test. Pan base, 140 g sauce, 305 g cheese, baked for 7 min at 250 ° C

EXAMPLE 2:

mozzarella/mozzarella-like cheese made where gum was added prior to pasteurisation

Five cheeses (5 Controls and 5 experimental) were made using the manufacturing protocol as described above, and the functionality assessed using the pizza test as above, when the cheeses were 6 weeks old, and again when the cheeses were 9-12 weeks old. The description of the functional parameters as set out in Table 2, was replaced by a score system in this and later examples in an attempt to more easily compare control and test cheese batches and also to enable the scores of multiple analyses to be averaged out. The score sheet used to assess functionality is set out in Figure 3.

The assessment of functionality for these cheeses is shown below in Table 3. Each score is an average of the functional scores for five cheeses.

Table 3: **Functionality**

Age of cheese tested	6 weeks		9-12 weeks	
Cheese type	Control	0.025% gum*	Control	0.025% gum*
Blister size	5.64	4.02	6.80	4.02
Background colour	6.78	4.88	7.06	4.88
Oil Off	2.70	2.16	2.94	2.54
Tenderness in mouth	3.60	4.72	3.38	5.48
Tenderness on chew	4.16	5.64	3.74	5.94
Moisture content (%)	49.00	50.58	49.00	50.58

* kappa carrageenan

Results

From the results set out in the functionality Tables 2 and 3 above, it will be seen that the mozzarella cheese made according to the process of the present invention, whereby 0.025 wt% kappa carrageenan was added to the standardised cheese milk prior to pasteurisation, having a protein:fat ratio of 1.3 and initial fat content of approximately 2.6%, resulted in a cheese having improved functionality parameters as compared with a control cheese made without added gum. In particular, blister coverage, blister size, background colour, melt, oil off, stretch length, stretch type and moisture content were all improved in a standard in-house pizza test (details of which are available upon request). The beneficial properties of gum containing cheese increased when tested in mozzarella aged 9-12 weeks compared to 6 week old cheese (Table 3).

EXAMPLE 3:

mozzarella cheese made with different types of gum.

- 5 The manufacturing protocol was as described above, and the functionality of each single cheese made, tested by the pizza test as above when the cheeses were 9 weeks old. The score results in Table 4, below are the average of 3 evaluators.

Table 4: Functionality

Cheese type	Control	K-C	LBG	Guar
Blister coverage	5.8	4.6	5.2	3.6
Blister size	4.0	2.2	3.8	3.0
Blister colour	4.6	4.8	5.2	5.0
Background colour	6.4	4.8	6.2	5.8
Melt appearance	4.0	3.8	3.4	3.8
Oil Off	2.4	2.2	3.4	3.0
Stretch length	7.8	7.0	6.2	5.0
Stretch type	4.8	4.8	3.2	4.4
Tenderness in mouth	3.8	4.4	3.0	3.0
Tenderness on chew	4.8	6.2	3.2	3.0
Moisture content (%)	48.8	51.1	49.7	51.9

All gums:

K-C = Kappa carrageenan

LBG = Locus bean gum

Guar = Guar gum

added before pasteurisation at a concentration of 0.025 wt% in the cheese milk.

Results

- 20 From the results set out above in Table 4, it will be seen that all of the gums resulted in mozzarella cheese having improved functionality, and particularly a decreased blister size, decreased background colour and increased moisture content than the control cheese. K-carageenan overall gave the most pronounced effects.

EXAMPLE 4:

mozzarella cheese made with different amounts of kappa carrageenan.

The manufacturing protocol was as described in Example 1 above, and the functionality of each single cheese made was tested by the pizza test, as described above, when the cheeses were 12 weeks old. The score results in Table 5, below are the average of 3 evaluators.

Table 5: Functionality

Cheese type	Control	0.015 wt% K-C	0.020 wt% K-C	0.025 wt% K-C	0.030 wt% K-C
Blister coverage	6.0	5.3	5.3	6.0	6.0
Blister size	6.0	4.7	4.0	4.0	4.0
Blister colour	6.3	6.0	6.0	6.3	3.3
Background colour	7.0	5.3	5.0	5.0	5.3
Melt appearance	5.7	5.7	5.7	5.7	5.7
Oil Off	3.0	3.0	3.0	2.7	2.7
Stretch length	10.0	9.7	9.0	9.3	8.7
Stretch type	5.0	5.3	6.3	6.7	6.3
Tenderness in mouth	4.3	4.7	6.0	7.0	6.7
Tenderness on chew	5.7	6.0	6.3	6.7	7.7
Moisture content (%)	49.0	49.3	50.1	50.6	51.7

Results

From the results set out above in Table 5, it will be seen that increasing the level of gum added to the starting milk resulted in mozzarella cheese having increasingly improved functionality parameters. In particular, increased moisture content, decreased blister size, background colour (whiter), oil off and improved tenderness (initially and on chewing) resulted with increasing amounts of gum.

EXAMPLE 5:

mozzarella cheese made with mixtures of gums.

The manufacturing protocol was as described above, and the functionality of each single cheese made was tested by the pizza test, as described above, when the cheeses were 9 weeks old. The score results in Table 6, below, are the average of 3 evaluators.

Table 6: Functionality

Cheese type	K-C (0.025%)	K-C/LBG (0.017/0.05 wt%)	K-C/LBG (0.017/0.008 wt%)	K-C/Guar (0.017/0.008 wt%)
Blister coverage	4.7	4	4.0	3.7
Blister size	2.3	2.7	4.0	2.7
Blister colour	6.0	6.0	6.0	6.0
Background colour	4.7	4.7	5.0	5.0
Melt appearance	4.0	4	4.3	4.3
Oil Off	2.3	2.3	2.7	2.7
Stretch length	9	8.7	9.0	8.0
Stretch type	5.7	5.7	6.3	6.3
Tenderness in mouth	5.3	5.7	5.3	5.3
Tenderness on chew	6	6.7	6.0	6.3
Moisture content (%)	49.5	50.4	49.6	50.4

5 **Results**

From the results set out above in Table 6, it will be seen that the various gum mixtures added to the starting milk resulted in improved functional characteristics in mozzarella cheese, similar in magnitude to those produced with kappa carrageenan alone.

10 **EXAMPLE 6:**

mozzarella cheese made with different fat levels in cheese milk.

The manufacturing protocol was as described above except that the fat in the starting cheese milk varied as set out in Table 7 below. Functionality of each single cheese made was tested by using the pizza test, as described above, on cheeses that were 9 weeks old. The score results in Table 7, below, are the average of 3-5 evaluators.

Table 7: Functionality

Cheese type	Control	0.025:K-C	Control	0.025:K-C
% fat in cheese milk	2.54	2.54	1.63	1.63
Blister coverage	7.0	6.0	9.0	7.7
Blister size	7.0	3.7	9.3	6.0
Blister colour	6.7	5.7	6.7	5.0
Background colour	7	4.7	7.0	4.7
Melt appearance	5.3	4.0	6.3	4.0
Oil Off	3.0	2.7	1.3	1.3
Stretch length	8.0	8.3	5.3	7.0
Stretch type	3.0	4.3	3.0	4.7
Tenderness in mouth	3.3	5.0	2.7	4.0
Tenderness on chew	3.0	6.3	2.0	4.3
Moisture content (%)	48.2	50.3	51.1	51.5

Cheese type	Control	0.025:K-C	Control	0.025:K-C
% fat in cheese milk	0.53	0.53	3.89	3.89
Blister coverage	0	0	3.6	3.0
Blister size	0	0	3.4	1.8
Blister colour	1.2	1.2	5.8	5.2
Background colour	5.2	4.4	6.0	4.6
Melt appearance	1.6	2.0	6.0	6.4
Oil Off	1.0	1.0	6.2	3.2
Stretch length	3.2	5.8	7.6	6.8
Stretch type	2.0	2.8	5.8	6.6
Tenderness in mouth	2.0	2.6	4.6	5.4
Tenderness on chew	2.0	2.6	5.4	6.2
Moisture content (%)	54.4	55.6	43.2	46.3

Results

From the results set out above in Table 7, it will be seen that in general within each pair of fat levels where gum was added, there were overall improvements in functionality of the mozzarella cheese. In particular, blister coverage, blister size, background colour, oil off all decreased whilst tenderness (initially and on chewing) improved. Because of the low fat content of the Mozzarella made from the 0.53% fat containing milk, the surface of the molten cheese was heavily scabbed (no individual blisters) hence 0 scores for blister size and coverage. However background colour decreased in these cheeses and tenderness (initially and on chewing) improved in the low fat cheese with added gum compared to its Control. In all cases where gum was added cheese moisture (%) increased.

EXAMPLE 7:

mozzarella cheese made by adding gum (0.025 wt% kappa carrageenan) before and after pasteurisation.

The manufacturing protocol was as described above. Functionality of each single cheese made was measured using the pizza test, as described above, on 12 week old cheeses. The score results in Table 8, below, are the average of 3 evaluators.

Table 8: Functionality

Cheese type	Control	Gum added before pasteurisation	Gum added after pasteurisation
Blister coverage	6.0	5.3	4.7
Blister size	6.6	4.0	3.7
Blister colour	6.3	6.3	5.3
Background colour	7.3	5.0	5.0
Melt appearance	5.6	4.7	4.7
Oil Off	3.6	2.3	3.3
Stretch length	9.6	7.7	8.3
Stretch type	6.0	6.7	5.3
Tenderness in mouth	3.3	6.3	6.7
Tenderness on chew	4.0	6.7	5.7
Moisture content (%)	47.9	49.4	49.8

Results

From the results set out above in Table 8, it will be seen that gum added before and after pasteurisation resulted in mozzarella cheese with reduced blister size, blister cover and oil off and improved tenderness (both initially and on chewing) in the pizza test compared to the control. Background colour was also reduced where the gum was added before or after pasteurisation.

EXAMPLE 8:

comparison of mozzarella cheese made by adding different levels of guar gum before and after pasteurisation.

5

The manufacturing protocol was as described above. Functionality was measured using the pizza test on 6 week old cheeses. The score results below in Table 9 are the average of 5 evaluators.

10 **Table 9: Functionality**

Cheese type	Before pasteurisation		After pasteurisation	
	Control	0.15% Guar	Control	0.15% Guar
Blister coverage	4.2	4.4	4.2	6.0
Blister size	4.2	3.2	4.2	5.2
Blister colour	6.4	6.4	6.4	7.0
Background colour	7.6	5.6	7.6	7.6
Melt appearance	5.2	4.2	5.2	4.6
Oil Off	3.8	3.0	3.8	1.8
Stretch length	9.0	6.4	9.0	7.4
Stretch type	4.6	4.2	4.6	4.2
Tenderness in mouth	3.0	3.0	3.0	3.0
Tenderness on chew	3.8	4.0	3.8	3.4
Moisture content (%)	48.1	50.8	48.1	52.2

Results

From the results set out above in Table 9, it will be seen that gum added (0.15% guar) before and after pasteurisation increased the moisture content of the final cheese and reduced oil off. Blister size and background colour was also reduced when the gum was added before pasteurisation.

15

EXAMPLE 9:

comparison of mozzarella cheese made using different fat levels and 0.025 wt% kappa carrageenan before and after pasteurisation.

5

The manufacturing protocol was as described above. Functionality was measured using the pizza test on 6 week old cheeses. The score results below in Table 10, are the average of 5 evaluators.

10 **Table 10: Functionality**

Cheese type	Before pasteurisation			After pasteurisation		
	Control	0.5% fat	3.89% fat	Control	0.5% fat	3.89% fat
Blister coverage	0	0	3.0	3.6	0	3.2
Blister size	0	0	1.8	3.4	0	2.4
Blister colour	1.2	1.2	5.2	5.8	1.2	5.4
Background colour	5.2	4.4	4.6	6.0	4.4	5.2
Melt appearance	1.6	2.0	6.4	6.0	2	6.8
Oil Off	1.0	1.0	3.2	6.2	1	6.6
Stretch length	3.2	5.8	6.8	7.6	6.2	8
Stretch type	2.0	2.8	6.6	5.8	3.4	6
Tenderness in mouth	2.0	2.6	5.4	4.6	2.6	5.4
Tenderness on chew	2.0	2.6	6.2	5.4	3.2	6
Moisture content (%)	54.4	55.6	46.3	43.2	56.3	45.4

Results

From the results set out above in Table 10, it will be seen that, within a fat level and with the exception of oil off in the high fat version, cheese made where the gum was added before or after pasteurisation gave similar improvements in functional characteristics.

Conclusions

20

The present invention provides a process of making mozzarella cheese whereby gum is added to the starting milk before or after pasteurisation. Such a process results in improved functionality characteristics of the gum containing cheeses. Gum added at various levels, to milks with a range of fat contents, before or after pasteurisation, increases moisture levels in the final cheese and reduces blister size, blister cover, oil off and transparency of the molten cheese on a pizza. Background colour of the

25

molten cheese is whiter and tenderness (initially and on chewing) is improved. In addition cheese yield (moisture) and the window of functional acceptance is increased and shedability and diceability improved by the addition of gums.

5

INDUSTRIAL APPLICATION

The processes of the present invention and cheese made using the processes have
10 commercial application in the pizza making industry that utilises mozzarella and mozzarella-like (pizza) cheese in significant quantities.

It will be appreciated that it is not intended to limit the invention to the above
examples only, many variations, such as might readily occur to a person skilled in the
15 art being possible without departing from the scope of the appended claims.

WHAT WE CLAIM IS:

1. A process of making cheese comprising the steps:

- 5 a. providing a starting milk composition having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;
- b. adding a gum preparation to the starting milk composition of step a;
- c. pasteurising the milk composition of step b;
- 10 d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- e. coagulating the cheese milk composition;
- f. cutting the coagulum to separate curd and whey;
- g. draining away the whey from the curd; and
- 15 h. shaping and cooling the curd.

2. A process as claimed in claim 1, wherein the cheese is selected from the group comprising soft, semihard, hard and extra hard cheeses.

20 3. A process as claimed in claim 1 or 2, comprising a further step between step g and step h of heating and stretching the curd at a curd temperature of between 50°C to 80°C.

 4. A process as claimed in claim 3, wherein the cheese produced is a mozzarella or
25 mozzarella-like (pizza) cheese.

5. A process of making mozzarella or mozzarella-like (pizza) cheese comprising the steps:

- 30 a. providing a starting milk composition having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;

- b. adding a gum preparation to the starting milk composition of step a;
- c. pasteurising the milk composition of step b ;
- d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- 5 e. coagulating the cheese milk composition;
- f. cutting the coagulum to separate curd and whey;
- g. draining away the whey from the curd;
- h. heating and stretching the curd at a curd temperature of between about 50°C to 80°C; and
- 10 i. shaping and cooling the curd.

6. A process as claimed in claim 1 or 5, wherein the starting milk is selected from one or more of the group comprising whole fat milk; semi skimmed milk; skimmed milk; butter milk; butter milk retentate/concentrate; whey protein retentate/concentrate; reconstituted whole milk powder, skimmed milk powder, whey protein concentrate powder, whey protein isolate powder, buttermilk powder or other powders made from milk; and dry powdered milk products reconstituted with any of the above liquid milk products.

7. A process as claimed in claim 6, wherein the starting milk is sourced from any milk producing animal.

8. A process as claimed in claim 1 or 5, wherein the protein and fat composition of the starting milk composition is standardised to give a protein/fat ratio of between about 0.5:1 and 6.0:1.

9. A process as claimed in claim 1 or 5, wherein the starting milk has a fat content of between about 0.5-6.0% to give concentration in the final cheese product of between about 4-30 wt%.

10. A process as claimed in claim 1 or 5, wherein the gum is selected from one or more of the group comprising kappa carrageenan, iota carrageenan, lambda

carrageenan, locust bean gum, alginate, xanthan, cellulose gum, guar, and any other suitable hydrocolloid.

11. A process as claimed in claim 10, wherein the gum is a carrageenan.

12. A process as claimed in claim 11, wherein the gum is predominantly kappa carrageenan.

13. A process as claimed in claim 1 or 5, wherein the gum is added as a dry powder or as a solution.

14. A process as claimed in claim 1 or 5, wherein the concentration of gum in the starting milk is between about 0.005-0.25 wt%.

15. A process as claimed in claim 14, wherein the concentration of gum in the starting milk is between about 0.010-0.2 wt%.

16. A process as claimed in claim 15, wherein the concentration of gum in the starting milk is between about 0.015-0.15 wt%.

17. A process as claimed in claim 1 or 5, wherein the gum concentration in the starting milk is between about $1.00-100 \times 10^{-3}$ g/g of protein.

18. A process as claimed in claim 17, wherein the gum concentration in the starting milk is between about $1.4-60 \times 10^{-3}$ g/g of protein.

19. A process as claimed in claim 18, wherein the gum concentration in the starting milk is between about $4.0-45 \times 10^{-3}$ g/g of protein.

20. A process as claimed in claim 3 or 5, wherein the curd is heated and stretched at a curd temperature of between about 50°C to 80°C in hot water or hot whey.

21. A process as claimed in claim 3 or 5, wherein the curd is heated and stretched in a substantially dry environment at a curd temperature of between about 50°C to 80°C.

22. A process as claimed in any one of claims 1 to 21, wherein at least one additive common in the cheese making industry is added at any suitable step in the process, wherein said at least one additive is selected from the group comprising non-dairy ingredients such as stabilisers, emulsifiers, natural or artificial flavours, colours, starches, water, additional gums, lipases, proteases, mineral and organic acid, structural protein (soy protein or wheat protein), anti microbial agents, and dairy ingredients.

23. A process of making cheese comprising the steps:

- a. providing a starting milk compositions having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;
- b. pasteurising the starting milk composition of step a;
- c. adding a gum preparation to the milk composition of step b;
- d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- e. coagulating the cheese milk composition;
- f. cutting the coagulum to separate curd and whey;
- g. draining away the whey from the curd; and
- h. shaping and cooling the curd.

24. A process as claimed in claim 23, wherein the cheese is selected from the group comprising soft, semihard, hard and extra hard cheeses.

25. A process as claimed in claim 23 or 24, comprising a further step between step g and step h of heating and stretching the curd at a curd temperature of between 50°C and 80°C.

26. A process as claimed in claim 25, wherein the cheese is mozzarella or mozzarella-like (pizza) cheese.

27. A process of making a mozzarella or mozzarella-like (pizza) cheese comprising the steps:

- a. providing a starting milk composition having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;
- b. pasteurising the starting milk composition of step a;
- c. adding a gum preparation to the milk composition of step b;
- d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- e. coagulating the cheese composition,
- f. cutting of the coagulum to separate curd and whey;
- g. draining away the whey from the curd;
- h. heating and stretching the curd at a curd temperature of between about 50°C to 80°C; and
- i. shaping and cooling the curd.

28. A process as claimed in claim 23 or 27, wherein the starting milk is selected from one or more of the group comprising whole fat milk; semi skimmed milk; skimmed milk; butter milk; butter milk retentate/concentrate; whey protein retentate/concentrate; reconstituted whole milk powder, skimmed milk powder, whey protein concentrate powder, whey protein isolate powder, buttermilk powder or other powders made from milk; and dry powdered milk products reconstituted with any of the above liquid milk products.

29. A process as claimed in claim 28, wherein the starting milk is sourced from any milk producing animal.

30. A process as claimed in claim 23 or 27, wherein the protein and fat composition of the starting milk composition is standardised to give a protein/fat ratio of between about 0.5:1 and 6.0:1.

5 31. A process as claimed in claim 23 or 27, wherein the starting milk has a fat content of between about 0.5-6.0% to give concentration in the final cheese product of between about 4-30 wt%.

32. A process as claimed in claim 23 or 27, wherein the gum is selected from one or
10 more of the group comprising kappa carrageenan, iota carrageenan, lambda carrageenan, locust bean gum, alginate, xanthan, cellulose gum, guar, and any other suitable hydrocolloid.

33. A process as claimed in claim 32, wherein the gum is a carrageenan.

15 34. A process as claimed in claim 33, wherein the gum is predominantly kappa carrageenan.

35. A process as claimed in claim 23 or 27, wherein the gum is added as a dry
20 powder or a solution.

36. A process as claimed in claim 23 or 27, wherein the concentration of gum in the starting milk is between about 0.005-0.25 wt%.

25 37. A process as claimed in claim 36, wherein the concentration of gum in the starting milk is between about 0.010-0.2 wt%.

38. A process as claimed in claim 37, wherein the concentration of gum in the starting milk is between about 0.015-0.15 wt%.

30 39. A process as claimed in claim 23 or 27, wherein the gum concentration in the starting milk is between about $1.00-100 \times 10^{-3}$ g/g of protein.

40. A process as claimed in claim 39, wherein the gum concentration in the starting milk is between about $1.4\text{--}60 \times 10^{-3}$ g/g of protein.

41. A process as claimed in claim 40, wherein the gum concentration in the starting milk is between about $4.0\text{--}45 \times 10^{-3}$ g/g of protein.

42. A process as claimed in claim 25 or 27 wherein the curd is heated and stretched at a curd temperature of between about 50°C to 80°C in hot water or hot whey.

43. A process as claimed in claim 25 or 27 wherein the curd is heated and stretched in a dry environment at a curd temperature of between about 50°C to 80°C .

44. A process as claimed in any one of claims 23 to 43, wherein at least one additive common in the cheese making industry is added at any suitable step in the process, wherein said at least one additive is selected from the group comprising non-dairy ingredients such as stabilisers, emulsifiers, natural or artificial flavours, colours, starches, water, additional gums, lipases, proteases, mineral and organic acid, structural protein (soy protein or wheat protein), anti microbial agents, and dairy ingredients.

45. A cheese produced by the process of any one of claims 1 to 44.

46. A mozzarella or mozzarella-like cheese product produced by the processes of any one of claims 1 to 44.

47. A food product comprising the cheese of claim 45.

48. A food product comprising the mozzarella or mozzarella-like cheese of claim 46.

49. A food product as claimed in claim 47 or 48, comprising a pizza.

AMENDED CLAIMS

[received by the International Bureau on 1 February 2002 (01.02.02);
original claims 6 and 28 amended; remaining claims unchanged (2 pages)]

- b. adding a gum preparation to the starting milk composition of step a;
- c. pasteurising the milk composition of step b ;
- d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- 5 e. coagulating the cheese milk composition;
- f. cutting the coagulum to separate curd and whey;
- g. draining away the whey from the curd;
- h. heating and stretching the curd at a curd temperature of between about 50°C to 80°C; and
- 10 i. shaping and cooling the curd.

6. A process as claimed in claim 1 or 5, wherein the starting milk is selected from one or more of the group comprising whole fat milk; semi skimmed milk; skimmed milk; butter milk; butter milk retentate/concentrate; whey protein retentate/concentrate; reconstituted
15 whole milk powder, skimmed milk powder, whey protein concentrate powder, whey protein isolate powder, buttermilk powder or other powders made from milk; and dry powdered milk products reconstituted with any of the above liquid milk products, wherein the fat content of the starting milk is adjusted where necessary to more than 0.3% fat.

20 7. A process as claimed in claim 6, wherein the starting milk is sourced from any milk producing animal.

8. A process as claimed in claim 1 or 5, wherein the protein and fat composition of the starting milk composition is standardised to give a protein/fat ratio of between about 0.5:1 and
25 6.0:1.

9. A process as claimed in claim 1 or 5, wherein the starting milk has a fat content of between about 0.5-6.0% to give concentration in the final cheese product of between about 4-30 wt%.

30 10. A process as claimed in claim 1 or 5, wherein the gum is selected from one or more of the group comprising kappa carrageenan, iota carrageenan, lambda

26. A process as claimed in claim 25, wherein the cheese is mozzarella or mozzarella-like (pizza) cheese.

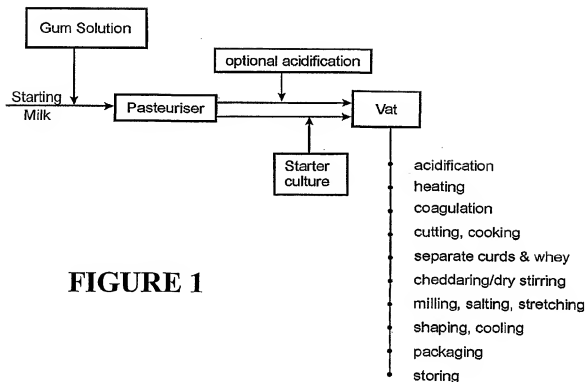
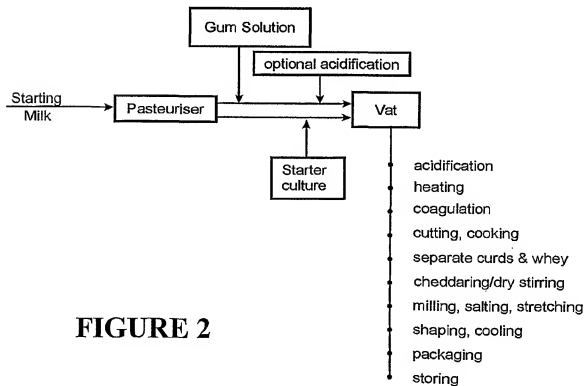
27. A process of making a mozzarella or mozzarella-like (pizza) cheese comprising the steps:

- a. providing a starting milk composition having a selected protein and fat composition, wherein said starting milk has a fat content of more than 0.3%;
- b. pasteurising the starting milk composition of step a;
- c. adding a gum preparation to the milk composition of step b;
- d. adding a starter culture and/or acid (organic or mineral) to the milk composition to form a cheese milk;
- e. coagulating the cheese composition,
- f. cutting of the coagulum to separate curd and whey;
- g. draining away the whey from the curd;
- h. heating and stretching the curd at a curd temperature of between about 50°C to 80°C; and
- i. shaping and cooling the curd.

28. A process as claimed in claim 23 or 27, wherein the starting milk is selected from one or more of the group comprising whole fat milk; semi skimmed milk; skimmed milk; butter milk; butter milk retentate/concentrate; whey protein retentate/concentrate; reconstituted whole milk powder, skimmed milk powder, whey protein concentrate powder, whey protein isolate powder, buttermilk powder or other powders made from milk; and dry powdered milk products reconstituted with any of the above liquid milk products, wherein the fat content of the starting milk is adjusted where necessary to more than 0.3% fat, wherein the fat content of the starting milk is adjusted where necessary to more than 0.3%.

29. A process as claimed in claim 28, wherein the starting milk is sourced from any milk producing animal.

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**FIGURE 1****FIGURE 2**

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NZDRI ATTRIBUTE SCORE CHART FOR PIZZA FUNCTIONALITY

ATTRIBUTE	DESCRIPTION	SCORE	SCORE	COMMENTS
Blister coverage	0/burnt tips	1	20-25%	The appearance of burnt tips should be noted
	0-5%	2	25-30%	
	5-10%	3	35-40%	
	10-15%	4	40-50%	
	15-20%	5	>50%	
Blister size	0-5mm		1-2	Blister integrity (flat, raised scabbed etc) should be described here.
	5-10mm		3-4	
	10-15mm		5-6	
	15-20mm		7-8	
	20-25mm		9-10	
Skinning/ Excessive blistering	None		1-2	
	Slight		3-4	
	Medium		5-6	
	Heavy		7-8	
	Complete crust		9-10	
Blister colour	No colour/v light brown		1-2	
	Light brown		3-4	
	Brown		5-6	
	Dark brown		7-8	
	Black/burnt		9-10	
Background colour (oven + 20 mins)	Transparent		1-2	
	Transparent to white		3-4	
	White to pale yellow		5-6	
	Pale yellow to yellow		7-8	
	Yellow to brown		9-10	
Melt appearance	Complete to moderate unmelt		1-2	Location (top/underneath) should be noted. Sauce holes or sauce cracks should be noted
	Moderate to slight unmelt		3-4	
	Completely melted		5-6	
	Slightly soupy		7-8	
	Soupy		9-10	
Oil off	None to slight		1-2	
	Slight to moderate		3-4	
	Moderate to heavy		5-6	
	Heavy to excessive		7-8	
	Flooded		9-10	
Stretch length	0-100mm		1-2	Should be determined 2-3 mins from oven and stretch length based on the average of 3 estimates (NB stretch length cats changed 2/8/01)
	100-200mm		3-4	
	200-300mm		5-6	
	300-400mm		7-8	
	>400mm		9-10	
Stretch type	Fibrous with a lot of top tension		1-2	
	Fibrous/ribbon-like with top tension		3-4	
	Thread-like with little top tension		5-6	
	Fine strands /soupy		7-8	
	Fine strands/soup/none		9-10	
Tenderness (Initially)	Rubbery/solid-like		1-3	Should be judged by the initial mouthfeel and then by its texture change during chewing (6-8 chews)
	Soft/tender		4-7	
	Watery/liquid-like		8-10	
Tenderness (on chewing)	Forms a bolus on chewing, difficult to swallow		1-2	
	Goes tough/chewy/mealy/dry, difficult to swallow		3-4	
	Goes sloughy/chewy/mealy/dry, easier to swallow		5-6	
	Breaks down on chewing, easy to swallow		7-8	
	Watery, no substance on chewing		9-10	
Flavour				Should be noted

FIGURE 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ01/00198

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl. ⁷ : A23C 19/05		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) A23C 19/05		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched SEE ELECTRONIC DATA BASES		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPIDS, FASTA, CA: A23C 19, cheese, gums, gums and mucliages, guar gum, locust bean gum carrageen*, alginate, xanthan, cellulose, hydrocolloid, starch, mozzarella, pasta filata, pizza cheese		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 895 671 A (ADAMANY et al) 20 April 1999 Whole Document	1 - 49
X	US 5 709 900 A (MILLER et al) 20 January 1998 Whole Document	1 - 49
X	WO 91/17663 A1 (FIRST WORLD CHEESE) 28 November 1991 Whole Document	1 - 49
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"B" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search 19 December 2001		Date of mailing of the international search report 27 DEC 2001
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustrialia.gov.au Facsimile No. (02) 6285 3929		Authorized officer CRAIG ALLATT Telephone No : (02) 6283 2414

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NZ01/00198

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member			
US	5895671	US	6258389	US	2001046532	
WO	9117663	AU	78795/91	IE	911613	
		US	5080913	NZ	238108	
US	5709900	AU	16801/95	CA	2158267	
		EP	693881	CN	1123516	
			US	5532018	WO	9521534
END OF ANNEX						